

Attachment #1

Material Safety Data Sheet

This attachment provides the Material Safety Data Sheet (MSDS) covering the five (5) grades of the new chemical substances.

Material Safety Data Sheet(MSDS)

1. IDENTIFICATION

A. Product Name

- Carbon Nanotube

B. Recommended Use and Restriction on Use

☐ General Use : Polymeric additive manufacturing

☐ Restriction on Use : Not available

C. Information of Manufacturer

- Manufacturer

☐ Company name : Korea Kumho Petrochemical Co., Ltd.

☐ Address :

Head office - East wing 10-14th Floor, Signature Towers, 100

Cheonggyecheon-ro, Jung-gu, Seoul, Korea

Plant - 958, Oncheon-dae-ro, Sinchang-myeon, Asan-si,

Chungcheongnam-do, Korea

☐ Dept. : CNT Production Technology Team

☐ Person in charge :

☐ Telephone number : +82-2-6961-1114(Head office)

+82-41-423-3114(Plant)

☐ Fax number : +82-41-423-3199(Plant)

☐ Emergency :

- Supplier / distributor

☐ Company name :

☐ Address :

☐ Dept. :

☐ Person in charge :

☐ Telephone number :

☐ Fax number :

☐ Emergency :

2. HAZARD IDENTIFICATION

A. GHS Classification :

- Serious eye damage/irritation : Category 2
- Specific target organ toxicity (Single exposure)
: Category 3 (Respiratory tract irritation)

B. GHS label elements

☐ Hazard symbols :



☐ Signal words : Warning

☐ Hazard statements :

- H319 Causes serious eye irritation
- H335 May cause respiratory irritation.

☐ Precautionary statements :

- Prevention
 - P261 Avoid breathing dust/fume/gas/mist/vapors/spray.
 - P264 Wash hands thoroughly after handling.
 - P271 Use only outdoors or in a well-ventilated area.
 - P280 Wear protective gloves/protective clothing/eye protection/face protection.
- Response
 - P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
 - P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
 - P312 Call a POISON CENTER or doctor/physician if you feel unwell.
 - P337+P313 If eye irritation persists: Get medical advice/attention.
- Storage
 - P403+P233 Store in a well-ventilated place. Keep container tightly closed.
 - P405 Store locked up.

- Disposal
 - P501 Dispose of contents/container in accordance with local/regional/national/international regulation.

C. Other hazards which do not result in classification :

- NFPA rating: (0-4 steps)
 - Health : 0, Flammability : 0, Reactivity : 0

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	Generic Name	CAS No.	Contents(%)
Carbon Nanotube	CNT	7782-42-5	> 94%
Metal Oxides		Proprietary	< 6%

4. FIRST-AID MEASURES

A. Eye Contact :

- Immediately flush eyes with plenty of water for at least 15minutes.
- Lifting eyelids occasionally to wash eyelids down enough to follow up.
- Get medical attention immediately.

B. Skin Contact :

- Remove contaminated clothing and shoes immediately.
- Gently wash with plenty of soap and water.
- Laundry and dry thoroughly the contaminated clothing and shoes before reuse.
- Call a physician if necessary.

C. Inhalation :

- Go to where the air is clear.
- If not breathing, give artificial respiration.
- If breathing is difficult or symptoms persist, get a doctor's examination.
- Take the immediate medical examination.

D. Ingestion :

- Rinse your mouth with water immediately.
- If large quantities of this material are swallowed, call a physician immediately.

E. Notes to physician :

- Notify medical personnel of contaminated situations and have them take appropriate protective measures.

5. FIRE FIGHTING MEASURE

A. Suitable (Unsuitable) extinguishing media :

- Extinguishing media : Dry chemical, Extinguishing agent, CO₂,
Water spray
- Unsuitable Extinguishing media : Not available

B. Specific hazards arising from the chemical

- Combustion products : CO, CO₂, Fume
- fire and explosion hazards : Dust / air mixtures may ignite or
explode. Contact with water or damp
air,
you may be burned.

C. Fire fighting procedures and equipments :

- A self-contained respirator and protective clothing.
- Move containers from fire area, if you can do without the risk.
- Cool containers with water until well after fire is out.
- Do not scatter spilled material with high-pressure water streams.
- Do not inhale the material or its combustion products.
- Stay upwind and keep out of low areas.

6. ACCIDENTAL RELEASE MEASURES

A. Personal Precautions, Protective Equipment and Emergency procedures :

- Perform in accordance with 「See section 8. EXPOSURE CONTROLS /
PERSONAL PROTECTION」. Put on appropriate personal protective
equipment.

- keep unauthorized personnel out.
- Remove all sources of ignition.
- Ventilate leak areas and clearing leak area.
- Wash thoroughly after handling.

B. Environmental precautions :

- Avoid dispersal of spilt material and runoff and contact with waterways, drains and sewers. If large spills, advise emergency services.

C. Methods and materials for containment and cleaning up :

- Small spill : Appropriate container for disposal of spilled material collected. Move container to safe area from the leak area.
- Large spill : Moist with water to prevent dust scattering. Dike for later disposal.
- If water spill, remove from surface by skimming or with suitable absorbent.
- Place absorbent and other waste in an appropriate container for disposal.
- Dispose of waste in accordance with local regulation.

7. HANDLING AND STORAGE

A. Handling :

- Perform in accordance with 「See section 8 . EXPOSURE CONTROLS / PERSONAL PROTECTION」 . Put on appropriate personal protective equipment.
- Use in a well-ventilated area.
- Suppression occurrence of dust.
- Wash thoroughly after handling.
- Avoid eye, skin, and clothing.
- Avoid ingestion and inhalation.

B. Storage Precautionary Statements :

- Save sealed in cool place.
- Avoid contact with incompatible materials.
- Heat, sparks, flames should be stored in isolate.
- Avoid contact moisture.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

A. Exposure limits

- Exposure limits in Korea :
Synthetic Graphite - TWA 2 mg/m³ Graphite(respirable)
- ACGIH TLV :
Synthetic Graphite - ACGIH(TLV) TWA 2 mg/m³
- Biological limit values : Not applicable

B. Engineering controls

- A system of local and/or general exhaust is recommended to keep employee exposures above the Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. The use of local exhaust ventilation is recommended to control emissions near the source.

C. Personal protective equipment

- Respiratory protection : Use the respirator be given official approval by Korea Occupational Safety & Health Agency. Under conditions of frequent use or heavy exposure, Respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.
 - Dust, mist, fume-purifying respiratory protection.
 - Any air-purifying respirator with a corpuscle filter of high efficiency
 - Any respiratory protection with a electromotion fan(for dust, mist, fume-purifying) High-efficiency particulate filter respirator attached self-service protector.
- ※ For Unknown Concentration or Immediately Dangerous to Life or Health
 - Supplied-air respirator (Hybrid air-line mask).
 - Supplied-air respirator with full facepiece
- Eye protection : Wear primary eye protection such as splash resistant safety goggles with a secondary protection face shield. Provide an emergency eye wash station and quick drench shower in the immediate work area.

- Hand Protection : Wear appropriate glove.
- Body Protection : Wear appropriate clothes.

9. PHYSICAL AND CHEMICAL PROPERTIES

- A. Appearance : Solid black powder
- B. Odor : Odorless
- C. Odor threshold : Not available
- D. pH : Not available
- E. Melting point/Freezing point : Not available
- F. Initial Boiling Point/Boiling Ranges : Not available
- G. Flash point : Not available
- H. Evaporating Rate : Not available
- I. Flammability(solid, gas) : Not available
- J. Upper/Lower Flammability or explosive limits : Not available
- K. Vapor pressure : Not available
- L. Solubility : insoluble in water
- M. Vapor density(Air=1) : Not available
- N. Relative density : 0.015~0.030g/mL (Powder), 0.060~0.140g/mL (Pellet)
- O. Partition coefficient of n-octanol/water : Not available
- P. Autoignition Temperature : Not available
- Q. Decomposition Temperature : Not available
- R. Viscosity : Not available
- S. Molecular weight : Not available

10. STABILITY AND REACTIVITY

- A. Chemical stability :
 - This material is stable under recommended storage and handling conditions.
 - Hazardous reaction will not occur.
- B. Conditions to Avoid :
 - Avoid contact with heat, open flames, sparks and other source of ignition.
 - Avoid contact with incompatible materials.
- C. Incompatible materials :

- Strong oxidizing agents, Strong reducing agents, Halogen

D. Hazardous decomposition products :

- Smog, CO, CO₂

11. TOXICOLOGICAL INFORMATION

A. Information on the likely routes of exposure

- ☐ (Respiratory tracts) : May cause respiratory irritation.
- ☐ (Oral) : Not available
- ☐ (Eye-Skin) : Causes serious eye irritation.

B. Delayed and immediate effects and also chronic effects from short and long term exposure

- ☐ Acute toxicity : Not available
- ☐ Skin corrosion/irritation :
 - Not a skin irritant in rabbits ; OECD TG 404(product)
- ☐ Serious eye damage/irritation :
 - Irritating to eyes and mucous membranes on contact.
- ☐ Respiratory sensitization : Not available
- ☐ Skin sensitization : Not available
- ☐ Carcinogenicity :
 - Not classify to be carcinogenic substance(A1) and carcinogenic substance(A2) of presumed in Public notice.
 - NTP, IARC, OSHA : Not classified
- ☐ Cell mutagenicity : Not available
- ☐ Reproductive toxicity : Not available
- ☐ Specific Target organ Toxicity(single exposure) : Not available
- ☐ Specific Target organ Toxicity(repeated exposure) :
 - Inhalation of natural or synthetic graphite worker may cause pneumoconiosis.
- ☐ Aspiration hazard : Not available

12. ECOLOGICAL INFORMATION

A. Ecotoxicity : Not available

B. Persistence and degradability : Not available

C. Bioaccumulative potential : Not available

D. Mobility in soil : Not available

E. Other adverse effects :

- This product will expose to the aquatic environment.

13. DISPOSAL CONSIDERATIONS

A. Disposal methods

- Dispose of waste in accordance with all applicable laws and regulations.
- Carbon nanotube and container will be careful not to be exposed to the environment.

B. Special precautions for disposal :

- The user of this product must disposal by oneself or entrust to waste disposer or person who other's waste recycle and dispose, person who establish and operate waste disposal facilities.
- Dispose of waste in accordance with all applicable laws and regulations.

14. TRANSPORT INFORMATION

A. UN Number : Not regulated for transport of dangerous goods.

B. UN Proper Shipping name : Not available

C. Transport hazard class(es) : Not available

D. Packing group : Not available

E. Sea pollutants : Not applicable

F. Special precautions for user related to transport or transportation measures :

1) EmS FIRE SCHEDULE : F-A

2) EmS SPILLAGE SCHEDULE : Not available

- Local transport in accordance with Dangerous goods Safety Management Law.
- Package and transport in accordance with Department of Transportation (DOT) and other regulatory agency requirements.

15. REGULATORY INFORMATION

A. Korea Industry Safety and Health Law (ISHL) :

- ☐ This product is Working Environment Measurement materials under ISHL Article 42. [Graphite]
- ☐ This product is Material exposure standard under ISHL Article 42 [Labor notice 2012-31]. [Synthetic Graphite]
- ☐ This product is not subject to the chemical hazardous substances by the management target under ISHL Article 420,439,440. Table 12.
- ☐ This product is Special Health Diagnoses under ISHL Article 43.

B. The Toxic Chemical Control Act in Korea(TCCA)

- ☐ This product is not classified as Toxic chemical and Observational chemical under TCCA Article 2.3. and 2.4.
- ☐ Toxic Release Inventory(TRI) Chemicals : Not available
- ☐ Accident precaution chemicals : Not available

C. Dangerous goods Safety Management Law in Korea :

- ☐ Dangerous goods Safety Management Act (Appendix 1) : Not applicable

D. Waste Management Law :

- ☐ This product waste from the workplaces of the Waste Management Act [Appendix 1]

E. Other local or international regulation

- ☐ POPs Management Law : Not applicable
- ☐ Rotterdam Convention listed ingredients : Not applicable
- ☐ Stockholm Convention listed ingredients : Not applicable
- ☐ Montreal Protocol listed ingredients : Not applicable
- ☐ Information of EU Classification : Not applicable
- ☐ U.S. Federal regulations
 - OSHA PROCESS SAFETY (29CFR1910.119) : Not applicable
 - CERCLA Section 103 (40CFR302.4) : Not applicable
 - EPCRA Section 302 (40CFR355.30) : Not applicable
 - EPCRA Section 304 (40CFR355.40) : Not applicable
 - EPCRA Section 313 (40CFR372.65) : Not applicable

- TSCA: This substance is not listed on the Toxic Substances Control Act (TSCA) Chemical Substance Inventory. This substance may only be used for experimental purposes under the TSCA R&D Exemption in accordance with the regulations at 40 CFR 720.36. Commercial use is prohibited.

16. OTHER INFORMATION

A. Reference

- This MSDS is prepared in accordance with ISHL Article 41 and MOL Notification No. 12-14 in Korea and consider the internal regulations by Korea Kumho Petrochemical Co., Ltd.

B. Issue date : 2009. 7. 6.

C. Revision number and Last date revised : 3rd time, 2015. 3. 31.

D. Other : Not available